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COMPARISION OF THE EFFECT OF REVERSE TRENDELENBERG POSITION VERSUS RAMP POSITION DURING PREOXYGENATION ON SAFE NON HYPOXIC APNEA PERIOD IN OBESE PATIENTS

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ABSTRACT **OBJECTIVES:** To compare the effect of the reverse Trendelenburg position versus ramp on SNHAP, defined as the interval between the induction of anesthesia and the occurrence of oxygen saturation (SpO2) of 92% in obese patients. **MATERIALS AND METHODS:** In a randomised control study, 44 patients with minimal BMI 30 kg/m2 undergoing elective surgery under general anaesthesia were randomly allocated to either group 1 (RP- ramp position) and group 2 (RT- reverse Trendelenburg position) and the effects on SNHAP in two groups were compared. **RESULTS:** The RT group showed significantly longer SNHAP (251.3vs222.2 seconds, $p<0.05$) and faster return to 97% oxygen saturation after ventilation resumption (65.2vs73.4seconds, $p<0.05$) when compared with RP group. **CONCLUSION:** In obese population, preoxygenation in reverse Trendelenburg position allows increased time for endotracheal intubation and decrease risk of hypoxemia by increasing SNHAP, decreasing the time to obtain optimal preoxygenation and a faster return to safe saturation levels.

KEYWORDS : Obesity, Preoxygenation, Hypoxia, Positioning

INTRODUCTION

Obesity prevalence is increasing exponentially with rising number of patients requiring surgical interventions [1]. Obese patients are at higher risk of complications associated with airway management like hypoxia, difficult mask ventilation and tracheal intubation than non-obese patients during these interventions. They are also associated with reduced safe non-hypoxic apnea period (SNHAP) . The safe non-hypoxia apnea period is defined as the time interval after the onset of apnea before hypoxemia occurs [2]. Desaturation occurs more rapidly in obese patients when compared to lean patients despite similar preoxygenation [3],[4],[5].

Obese anaesthetized patients have decrease in FRC accompanied with decrease in lung compliance and increase in resistance in supine position [4], [5], [6], [7]. Cephalad displacement of the diaphragm during supine position reduces the oxygen reserve [8]. This further decreases the effectiveness of preoxygenation and results in shorter apnea time [9]. Though hypoxemia in obese individuals may be multifactorial, positioning during preoxygenation may be contributing factor [10]. Preoxygenation in a more upright position may provide larger lung volume and decreased tendency of atelectasis and effective oxygenation [8].

Anatomical as well as physiological alterations due to obesity in these patients pose significant challenge to anesthesiologists and necessitates the need to adapt to techniques that allow safe management during administration of anaesthesia.. Routine techniques and manuevers employed during preoxygenation of non obese individuals may not provide a longer window to overcome the challenges due to difficult airway. Since FRC varies considerably with the changes in body position, optimal positioning during preoxygenation is crucial . Optimal positioning allows more time to secure the airway, lengthens the safe non-hypoxia apnea period and decreases the incidence of hypoxia in obese patients. This prospective randomised study was intended to compare the effects of two different positions during preoxygenation. Thus, we compared the effect of reverse Trendelenburg position versus ramp position during preoxygenation on safe non-hypoxia apnea period in obese patients.

MATERIALS AND METHODS

This was a prospective randomised study conducted between February 2024 and September 2024 in the hospitals attached to Bangalore Medical College and Research institute. Our study had the approval from the Institutional Ethics Committee. In this randomised control study, 44 patients with minimal BMI 30 kg/m2 belonging to ASA grade I , II and III undergoing elective surgery under general anaesthesia were considered. The sample size of 40 was needed in each group. However, after including drop out compensation of 10%, sample size of 44 was considered and randomly allocated into either group. Patients fulfilling following criteria are included: Patients of age >18 years and <60 years, Patients willing to give informed written consent , Patients belonging to American Society of Anesthesiologist class 1,2 and 3, Patients with body mass index (BMI) of 30 kg·m−2 or more.The patients with anticipated difficult airway and known previous difficult intubation, patients with severe cardiac disorders such as severe cardiac failure. (defined as New York Heart Association classification of IV) , patients with severe respiratory disorders such as asthma, moderate and severe chronic obstructive pulmonary diseases and patients with high risk of gastroesophageal regurgitation, pregnancy, active tobacco use.

After obtaining personal informed consent from these patients, general demographic data regarding name, age, sex, height, weight and contact information were noted. All patients in the study will underwent a detailed history regarding duration of disease and previous treatment modalities, general physical and systemic examination. Patients were randomly allocated from www.random.org to either group I (RP i.e., ramp position) or group II (RT i.e., reverse Trendelenburg position) positioned in a 25º reverse Trendelenburg position. Head up tilt was given after measuring the angle with help of a protractor. After the intravenous placement, application of standard American Society of Anesthesiologist (ASA) monitors was done. Before the start of the pre oxygenation, for patients in both ramp position as well as reverse trendelenberg position anesthesia ventilator was set in spontaneous ventilation with the adjustable pressure-limiting valve set in the open position. In both groups, the inspiratory fraction of oxygen was set to 1.0, and the fresh gas flow was set to 10 L/min. The ventilatory interface used during preoxygenation was facemask and patients from both groups were asked to breathe normally during the 3-min pre oxygenation period (Group 1) or (Group 2). During preoxygenation, inspiratory and expiratory fractions of oxygen, carbon dioxide and minute ventilation were continuously monitored and displayed on the anesthesia. The time required to obtain a FetO2 of 0.90 was first recorded, with the final FetO2 value and the mean minute ventilation after the 3-min preoxygenation period. At the end of preoxygenation, anesthesia was induced with fentanyl 2 μg kg−1, propofol 2 mg kg−1 and succinylcholine 1.5 mg kg−1. Lean body weight was used for the calculation of propofol doses. After the induction of anesthesia, no ventilation was provided to the patient and orotracheal intubation was performed using either direct laryngoscopy (Macintosh or Miller blade) or video laryngoscopy once the patient was paralyzed. After intubation, breathing system was not connected. The duration of the SNHAP (until SpO2 had fallen up to 92%) was recorded. Then, the breathing system was reconnected. The anesthesia ventilator was set to volume-controlled ventilation at a frequency of 20 ventilations per minute, a tidal volume of 8 mL kg−1 of predicted ideal body weight and PEEP of 10 cm H2O until SpO2 reached 97%. The blood pressure was recorded every minute and the minimal SpO2 reached was recorded after resuming the ventilation.

PARAMETERS MEASURED:

1) SNHAP, defined as the interval between the induction of anesthesia and the occurrence of oxygen saturation (SpO2) upto 92%.
2) the time to obtain a FetO2 of 0.90.
3) the proportion of patients that reached 0.90 of FetO2.
4) the maximal FetO2 during preoxygenation.

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5) the time needed to return to a SpO2 of 97% after ventilation resumption.
6)the mean arterial pressure during the experimental period.

RESULT

The above parameters were recorded and the following statistical analysis methods were applied and the results were obtained. The collected data was entered in the Microsoft Excel 2016 and was analysed with IBM SPSS Statistics for Windows, Version 29.0.(Armonk, NY: IBM Corp).To describe about the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables and for continuous variables the mean and S.D was used. To find the significant difference between the bivariate samples in independent groups the independent sample t-test or Mann-Whitney U test was used as on the normality of the data. To find the association of significance in categorical data the Chi-Square test or Fisher's exact test was used. Any other necessary test found appropriate was dealt at the time of analysis, based on the data distribution. In all the above statistical tools the probability value .05 was considered as significant level.

The two groups were similar with respect to age and gender distribution and difference was statistically insignificant (p >0.05).

The BMI was calculated and recorded for all patients in both groups and the mean BMI in the group A was 34.20 and group B was 34.24 (Table 1) which was statistically insignificant (p>0.05) as shown by Figure 1.

Figure 1: BMI between patients of two groups.

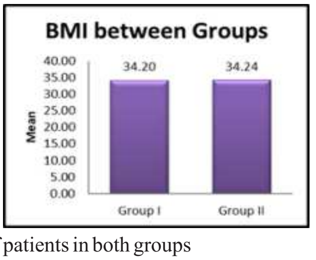

Table 1: BMI of patients in both groups

BMI	Group I	22	34.2	2.4
	Group II	22	34.2	1.9

The SNHAP were recorded and it was longer in RT group than in the RP group (251 (5.7) VS. 222.2(3.1) seconds, p value <0.05). (Figure 2, table 2)

Figure 2: SNHAP values in both groups

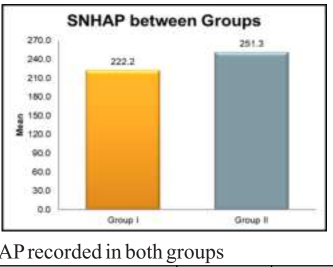

Table 2: SNHAP recorded in both groups

Groups		Mean	SD	p-value
	Group I	222.2	3.1	<0.05
	Group II	251.3	5.7	<0.05

During the preoxygenation phase, patients reached a FetO2 of 0.90 faster in the RT group than in the RP group (81.2 (7.0) vs. 122.6(7.1) seconds. (Figure 3, table 3)

Figure 3: time for Feto2 > 0.9 between the both the groups

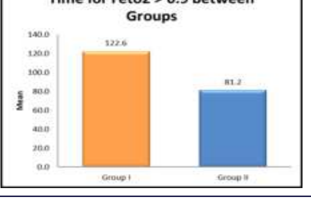

Table 3: TIME FOR FETO2 >0.9

Groups		Mean	SD	p- value
	Group I	122.6	7.1	<0.05
	Group II	81.2	7.0	<0.05

A higher proportion of patients in the RT group reached the satisfactory 0.90 of FetO2(90.9% VS. 50.0%) with p-value of <0.05.(Figure 4, Table 4).

Figure 4: the percentage of patients who reached satisfactory 0.90 of FetO2

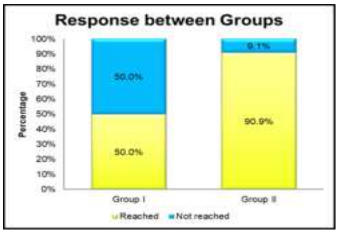

Table 4: Proportion if patients that reached Feto2>0.90

Groups		N	Mean	SD
	Group I	22	8.4	0.3
	Group II	22	11.1	0.2

Minute ventilation (MMV) was higher in the RT group than RP group.(Figure 5, Table 5) Figure 5: MMV between groups

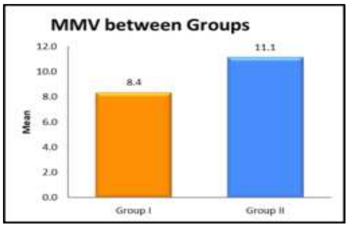

Table 5: mmv values and the p value

Groups		Mean	SD	p-value
	Group I	8.4	0.3	<0.05
	Group II	11.1	0.2	<0.05

After the resumption of ventilation, it took less time for the RT group to return to a 97% SpO2 in comparison to the RP group. (Figure 6, table 6)

Figure 6: Time for spo2 > 97 % between Groups

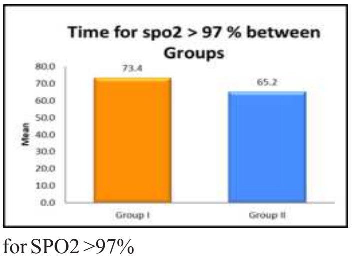

Table 6: time for SPO2 >97%

Groups		Mean	Sd	p-value
	Group I	73.4	3.2	<0.05
	Group II	65.2	2.6	<0.05

The mean arterial pressure was similar in both groups during the first 10 min of the experimental period and no vasoactive drugs were needed (95.5 vs 94.1 with p-value >0.05. (Figure 7, table 7)

Figure 7: MAP recorded between groups

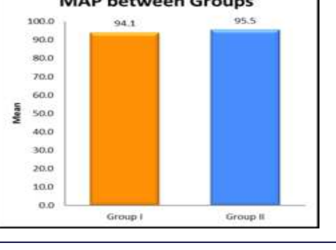

Table 7: values of MAP of two groups and the statistical values

Groups		Mean	SD	p-value
	Group I	94.1	7.3	>0.05
	Group II	95.5	8.2	>0.05

The parameters recorded between the two groups were recorded and noted

Table 8: enlist all the parameters recorded between the two groups

Primary objective	RP	RT
Safe non-hypoxic apnea period (seconds	222.2(3.1)	251.3(5.7)
Secondary objectives		
Time for FetO2 > 0.9 (seconds)	122.6(7.1)	81.2(7.0)
Maximal FetO2(%)	90.0(2.4)	93.1(2.6)
Time for SpO2> 97% (seconds)	73.4(3.2)	65.2(2.6)
Proportion of patients that reached FeO2 of 0.90 (%)	50.0%	90.9%

DISCUSSION

In this current era of epidemic of obesity, anaesthesiologists encounter many challenges during anaesthesia administration to obese individuals requiring surgery. Sticking to the basic protocols is absolutely important. However, obesity may pose increased incidence of complications during anaesthesia especially with respect to airway management. The increased risk of hypoxemia directly contrition the morbidity and mortality of the obese patients if not timely and adequately managed. BMI and FRC have inverse relationship with severely obese patients having two- third reduction in FRC.[11] They also have significantly lesser pulmonary reserve and residual volume .[12] Therefore, optimal preoxygenation techniques before induction of anaesthesia will definitely improve oxygenation and provide a safe margin of time to manage airway in obese individuals .

This randomised study reveals that the SNHAP is longer in the obese population when the preoxygenation of anaesthesia is done the Reverse trendelenberg position combination compared to a traditional standard care of preoxygenation in ramp position. These results were supported by secondary outcome measures confirming that preoxygenation in reverse trendelenberg position was also associated with improvements in all oxygenation parameters assessed such as the time to obtain a FetO2 of 0.90 , the proportion of patients that reached 0.90 of FetO2 , the maximal FetO2 during preoxygenation , the time needed to return to a SpO2 of 97% after ventilation resumption and mean arterial pressure during the experimental period.

In a study conducted by Dixon et al [8], this was a randomised control study concluded that the mean time for desaturation to 90% was significantly longer in the sitting group (90 degree) (214± 28s) as compared to compared to supine position (162± 38s) in obese patients. Similarly in this study we found out that, the SNHAP is longer in the obese population using the RT position compared to a routine standard of care i.e ramp position (251.3(5.7) vs. (222.2(3.1) seconds, p <0.05) . In both the studies, improved lung mechanics, lung volumes and FRC resulting in shorter apnea time were likely due to downward displacement of diaphragm during head up position.

In a study conducted by Yoganarasimha N et al [12] this randomised control study concluded that the duration of safe apnea period was longer ($p < 0.05$) when preoxygenation was done in 15° head-up tilt patients (423.1 ± 51.71s) as compared to compared to supine position (284.5± 29.51s). However, this study was done among non- obese healthy adults. Similarly in this study we found out that, the SNHAP is longer in the obese population using the RT position compared to a routine standard of care i.e ramp position (251.3(5.7) vs. (222.2(3.1) seconds, p <0.05).

Study conducted by F R Altermatt et al [9], a randomised control study concluded that the mean time for desaturation to 90% was significantly longer in the sitting group (90 degree) (214± 28s) as compared to compared to supine position (162± 38s) in obese patients. Similarly in this study we found out that, the SNHAP is longer in the obese population using the RT position compared to a routine standard of care i.e ramp position (251.3(5.7) vs. (222.2(3.1) seconds, p <0.05). In both the studies, obese patients have shorter apnea time in supine positions due to reduced FRC secondary to cephalad displacement of diaphragm caused by increased pressure of abdominal contents.

The main limitation of our study is that the attending anaesthesiologist was not blind to the group assignment. However , since the outcomes were objective measurements, the impact on the results was minimised.

CONCLUSION

Our study concluded that RT lengthened the SNHAP, decreased the time to obtain optimal preoxygenation conditions and allowed a faster resuming of secure oxygen saturation compared to RP in obese patients

The former combination thus allowed a more significant margin of time for endotracheal intubation and minimized the risk of hypoxemia in this highly vulnerable population.

Further studies are needed to evaluate the beneficial effects of the optimal position when combined with ventilation strategy individually to improve oxygenation parameters in obese patients undergoing general anesthesia.

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